LIVES AND WORKS

OF

Civil and Military Engineers

OF

AMERICA.

BY

CHARLES B. STUART, C. E.,

AUTHOR OF "NAVAL DRY DOCKS OF THE UNITED STATES," "NAVAL AND MAIL STEAMERS OF THE UNITED STATES;" LATE ENGINEER-IN-CHIEF OF THE U. S. NAVY, AND STATE ENGINEER AND SURVEYOR OF NEW YORK, ETC., ETC.

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COLONEL CHARLES ELLET, JR.,

CIVIL AND MILITARY ENGINEER.

THE public services of Charles Ellet, Jr., have not received the general recognition and appreciation they so highly merit. The Engineering profession in this country has never had a more industrious worker, or intelligent and original thinker. His vigorous mind challenged, with the greatest satisfaction, enterprises of a bold and difficult character. His views were broad and far-seeing; his judgment on matters pertaining to his profession, aided by his superior mathematical knowledge, was rarely at fault, although his opinions were often in advance of the times.

Work, persistent and unflagging, with brain and hand, was the means he used for attaining success, and no amount of discouragement or opposition with which he might be confronted, would deter him from pursuing his object, no matter how remote the end might at first seem to be. He was impatient of opposition, bearing down all objections by a torrent of argument, sustained by the most exact logical and mathematical deductions.

His career was full of interesting incidents, a few only of which can be embodied in this sketch, too brief to satisfy the desires of the compiler.

Charles Ellet, Jr., was born January first, eighteen hundred and ten, at Penn's Manor, Bucks County, Pennsylvania, within five miles of Bristol. Destined by his father to the life of a farmer, he received, in common with the children of his large family, the plain English education afforded by the country grammar schools of the time, and no other, with the exception of a few months' attendance upon a day-school in Philadelphia. He gave evidence, from an early period, of mental development, of the great mathematical talent for which he was afterwards distinguished, and at the age of fourteen or fifteen he began that insatiable pursuit of knowledge which enabled him, through many difficulties, to stock his ready mind and retentive memory with an extraordinary amount of information. At this period of his life he studied at every opportunity, hiding his books beneath his pillow in sickness, and carrying them with him to the plough and the harvest field. While thus eager after knowledge, he was conspicuous among the youth of his community for skill, agility and strength, and tales are still told of his daring feats, by those who knew him in his early days.

At the age of seventeen, young Ellet left home to serve for a few months as rodman, in a survey then being conducted by Canvass White, along the north branch of the Susquehanna, where he acquired the rudiments of his profession.

In eighteen hundred and twenty-eight he was appointed by Judge Wright, then Chief Engineer of the Chesapeake and Ohio Canal, to act as volunteer assistant, without any fixed position or salary. In this capacity he did almost all the office work of his party, drawing the maps and making the computations, almost without assistance, after walking from ten to twenty miles a day surveying, and fording the Potomac river in many places. He soon received from Judge Wright, as a recognition of his services, the position of Assistant Engineer of the Fifth Residency, under the supposition, afterwards admitted, that he was at least twenty-two years of age, and had considerable experience in engineering. During the whole period of his connection with the Chesapeake and Ohio Canal, he devoted every leisure hour to the prosecution of his studies, especially in the languages, for which he had a marked talent, and acquired command of several.

In two years, by great economy and self-denial, young Ellet had set aside from his slender salary a sufficient sum to enable him to go abroad and complete his education in Paris, where he spent the winter of eighteen hundred and thirty–thirty-one in close study, and in following the course of the *Ecole Polytechnique.* The knowledge of French which enabled him to do this had been gained since he left his home, in eighteen hundred and twenty-seven. He had the entrée into the most intellectual and interesting French society, where he was received in a very flattering manner. He declined all social overtures for the sake of his studies, with the exception of the kind attention of General Lafayette, whose interest in him was very marked, and who talked with him much of the political condition of France, and foretold to him the Revolution "*Des Trois Tours*" (which he witnessed within a week of the prediction), unless his Majesty "Charles the Tenth" should change his policy."

By husbanding every resource he made his small stock of money last through a year, during which time he visited England, and also travelled on foot through France and much of Germany, carefully examining the public works of these countries. He calculated his means so closely that on his journey home he was forced to sell many of his treasured books and instruments.

In eighteen hundred and thirty-two, when only twenty-two years of age, with a boldness and originality of thought and action, by which his whole professional career was so strongly characterized, he proposed to Congress a plan for the erection of a wire suspension bridge across the Potomac, of one thousand feet span. The novelty of the plan presented, and at a time, too, when the practicability of works of this nature had been demonstrated only in the mind of the Engineer, and the general principles of the subject so little known and understood by the public, met with no encouragement in the National Legislature.

In the summer of eighteen hundred and thirty-three he was engaged as Assistant Engineer in the location of the western division of the Utica and Schenectady Railroad, now part of the New York Central, under William C. Young, Chief Engineer.

The first survey of the western division of the New York and Erie Railroad (present Erie Railway) was conducted by him in eighteen hundred and thirty-four, and it is worthy of note that when, after being discontinued for several years, this enterprise was resumed, and the Engineers in charge endeavored to find a more favorable location, after an expenditure of much time and money upon other surveys, they fixed finally upon the line located by Ellet through the wilderness of Western New York, in the early part of his professional career.

In eighteen hundred and thirty-five he entered the service of the James River and Kanawha Canal Company, as Assistant, and was very soon appointed Chief Engineer of the entire work.

In compliance with a resolution of the Board of Directors he made, during the next year, a very able report on a survey for a ship canal from Richmond to Warwick, and presented a plan for the connection of the James River and Kanawha Improvement with tide water. He recommended the construction of a canal four and one-third miles in length, to extend from a basin to be raised by the construction of a dam across the river, below Mayo's Bridge, through the low grounds on the south side of James river, to the deep water at Warwick. The dimensions of the canal proposed were: width at surface one hundred and twenty feet, and at the bottom fifty-two feet, and seventeen feet deep. This was thought to be amply sufficient for the passage of the largest ships of that time from tide water to the wharves at Richmond.

His reasons for the construction of a canal instead of attempting to remove the obstructions between Rocketts and Warwick, and using the bed of the river, are clear and philosophical: "The bars, which are deposited at the head of tide, are formed by the materials brought down by the streams from the interior of the country, and they consist, in fact, of the waste of the whole district drained by the tributaries of the river, at the mouth of which the material subsides. This matter is loosened by the action of rains, and moved by the current, the heavier particles subsiding as the transporting power of the water diminishes, while the lighter are swept on and contribute to the formation of bars at the head of tide, and of deltas at the mouth of the streams. The deposit is greatest where the diminution of the fall of the river is most abrupt, and the resistance to the motion of the water is greatest, and, consequently, on approaching tide water, where the transporting power of the river is suddenly neutralized, much of the matter which was forced along the bottom is left by the current, and of that which was held in suspension, much is precipitated.

"The wearing away of the upland is unceasing, and the process of transportation is not less constant, and no plan for the navigation at the points where the resistance of the material which is deposited is superior to the tidal force, can be perfect which does not provide for the disposal of this matter.

"The objection, then, to the project of a dam below shoal water, and raising the surface from that point up to Richmond a sufficient height to float the shipping that can come to Warwick, is, that instead of disposing of this material, we prepare calm water to destroy the force of the current, and a basin to receive the sediment that is precipitated. We have not the necessary data to determine the time that would be required to fill this basin, so as to again interfere with the navigation of the pond ; but when we observe the great quantity of sediment that is discharged by the river at every freshet, and know that the deposit would occur chiefly above this dam, and that it would continue to increase until the depth of water would be reduced to the point where the transporting power would again become superior to the resistance, we shall appreciate the uncertainty of the expedient."

During the four years of his connection with this Canal Company he wrote many excellent pamphlets, reports, and articles for the public press, chiefly on topics relating to the improvement and prosperity of the State of Virginia ; and forcibly advocated a continuous line of improvements, extending from the Atlantic Ocean to the Ohio river, an enterprise now being consummated in the construction of the Chesapeake and Ohio Railroad.

While engaged upon this work, he married, in eighteen hundred and thirty-seven, Miss Daniel, daughter of Judge William Daniel, of Lynchburgh, Virginia, who proved a partner in every way worthy of her husband.

On retiring from the service of the James River and Kanawha Company, in eighteen hundred and thirty-nine, he returned to Philadelphia, where he published in the same year an "Essay on the Laws of Trade," a work of two hundred and eighty-two pages, devoted to the works of internal improvement in the United States. The subject of railroad, canal, and river transportation, was thoroughly examined and discussed. American internal improvement was then but in its initiative stage ; yet with remarkable judgment and keen perception he forecast the sources and lines of trade, as since developed ; the tonnage and cost of transportation; the sources of economy, and the causes from which failure might be apprehended. He earnestly advocated, and gave his reasons, which have been very generally verified by railroad practice, both in this country and in Europe, *for a low rate of speed in the movement of heavy freight trains, the use of heavier locomotives, and the construction of the most perfect and permanent road bed and superstructure.*

This work attracted much attention at the time, and was extensively read by statesmen, economists, and managers of railway and canal enterprises, and may, at the present day, be found profitable reading by the same class of public men.

In the same year he published his "Popular Exposition of the Incorrectness of the Tariffs of Toll in use on the Public Improvements of the United States," in which he "endeavors to demonstrate the incorrectness of the tariffs of toll in common use on the canals and railroads of this country, and to point out a method of assessing the charges on heavy tonnage, which will be the means of securing the highest revenue, and of rendering the tax on the public most equitable."

During the next few years Mr. Ellet gave to the Council of the city of St. Louis, a design and report for a suspension bridge across the Mississippi river at that city; was employed to survey the city and county of Philadelphia; paid a visit of some months to Cuba with a view to the restoration of his health, then so much impaired as never to be permanently restored; and issued a number of publications referring mainly to the railroads of the

United States, their tariffs, and the causes which conduced to their general want of prosperity. The following extracts will give, as briefly as can be condensed, his opinions on these subjects. After remarking, "there are completed, or in progress of construction,* between three and four thousand miles of railroads in the United States, on which have been expended more than one hundred millions of dollars," he says :—

"Of these works some few have thus far sustained themselves, and distributed considerable dividends; the receipts of some others are sufficient to keep them in repair, and pay the interest on the loans incurred for their construction, but the balance, having an aggregate length of some two thousand miles—the capitals may be regarded as positively sunk, and many of the companies as insolvent."

In his opinion "this disastrous result is not the consequence of attempting improvements in positions where trade and travel were insufficient to authorize the necessary outlay of capital; but proceeds from the fatal practice of imitation, and a thorough disrespect of first principles."

"The roads constructed by these unfortunate companies, instead of being such as appeared to be justified by the condition of the country in which they are situated, were only such as the Engineer, or President, or leading stockholders, had somewhere seen or read about. In the beginning there was no particular object proposed to be attained; and in the progress of the work, there was nothing to rule the general plans, or govern the arrangement of the detail—and they failed, of course."

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* 1841.

"The object of a railroad is to convey passengers and freight, and the first questions which every company about to embark in such an enterprise, should propose for examination is, What is the amount of trade and travel to be accommodated? for this amount furnishes us the value of the object sought by the improvement, and ought to prevent us from paying more for it than it is worth; and the second is, What should be the location and character of the road, and the character of its furniture, for the econominal accommodation of the trade which it is found may reasonably be anticipated." * * * * * * *

"The amount of trade to be accommodated has never yet governed the plan, location, and execution of any public work. All such enterprises in this country, and indeed nearly all the railroads in the world, bear one common impress, and every important sign of imitation of one common standard. They are all struck, as it were, with the same die, and belong to the same set. The same width of track, the same strength of rail, engines of the same weight, and cars of the same magnitude, prevail on the roads between the great cities, which carry half a million of tons, and some hundreds of thousands of passengers every year, and those of the obscurest districts of the United States, where as many persons and as much trade will scarcely be witnessed in the course of half a century."

"This imitation is universal. The same powerful engine, with its vast cars, is driven when loaded with a hundred tons of freight, or more than a hundred passengers, as when conveying its mere 'tender' and empty train. It is so universal that the expenses of transportation are now frequently estimated, by ascertaining the number of times the engine passes over the line, without reference at all .to the load which it draws. The error consists simply in providing a power too great for the business to be done."

"They make costly roads, build expensive superstructures, rear extravagant edifices, to contain their cars and engines, run heavy locomotives, and use carriages almost as capacious as dwelling-houses, to carry as many passengers as could, without much inconvenience, be drawn in a hand-cart."

"*If railroads do not sustain themselves it is not because they are railroads, but because great roads have been constructed where little ones only are required.* I do not believe that there has been such a work commenced, nor probably authorized, which could not pay a liberal and honest dividend, if the road, stock, and entire apparatus were duly proportioned to the duty to be performed." In making a homely comparison, he says: "The power contrived to drive a grist-mill, would make but small dividends if applied to turn a churn."

In further explanation of his views of railway economy, he remarks: "It is far from my object to advocate the exclusive employment of cheap roads, and light stock; my intention is only to recommend them as I would a light carriage, or light machine, when true economy, convenience, and comfort dictate their adoption. A large business will demand more extensive preparations."

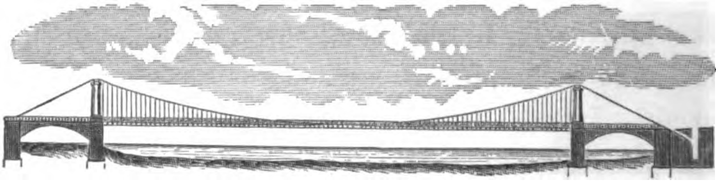
* * * An increase of business will give rise to improvements in the system adequate to its wants.

* * * When the business created by a population of many millions has to be transacted along a line of canal or railroad, every resource that can be obtained from the increasing application of science and art, will be brought in requisition."

* * * *

In eighteen hundred and forty-one and two, he designed and constructed the wire suspension bridge across the Schuylkill at Fairmount, the first structure of its kind in this country, and considered at the time a triumph of engineering skill.

This bridge still remains in good condition, after a service of thirty years of constant use, and is justly regarded with feelings of pride by the city of Philadelphia. Its destruction would be the removal of one of the most interesting landmarks of that city.



FAIRMOUNT BRIDGE.

After a second visit to Europe, Colonel Ellet engaged in the well-remembered controversy between the Schuylkill Navigation Company and the Reading Railroad. The discussion was carried on through the public press, and by circulars and pamphlets, and was conducted with much earnestness on both sides, and in which he fully established his reputation as a most forcible and unsparing writer.

In eighteen hundred and forty-six, he was chosen President of the Schuylkill Navigation Company, in which he was a large stockholder, and although in feeble health, and greatly hampered by strong opposition, he accomplished an almost incredible amount of labor.

The navigation was increased from a canal of a very irregular and contracted area to one averaging more than seventy feet in width ; from a depth of four feet to six feet, and from a capacity for boats of sixty tons to not less than one hundred and eighty tons burthen. Seventy-one locks, one hundred and eighteen feet long by eighteen feet wide, and eleven stop gates, were built; twenty-five culverts were lengthened, and four new ones built; ten aqueducts were raised, improved, and strengthened ; eighty-two bridges were raised, and seventy-four new ones built; twenty-two dams were permanently raised; two new channels were cut for the river ; eleven new guard locks were built, and many of the old ones raised and strengthened ; one hundred and twenty boats and scows, and one hundred and fifty additional cars, were constructed, besides many changes and enlargements made in waste weirs, sluices, and tow-paths.

In charge of divisions, Colonel Ellet had to assist him in arranging and carrying out his plans, Ellwood Morris, Antes Snyder, and James F. Smith, Civil Engineers of skill and experience.

The author, while engaged in locating the Great Western Railway of Canada, and what is now the Rochester and Niagara Falls branch of the New York Central Railroad, proposed to connect them by a railway suspension bridge over the Niagara river, between the Falls and the "Whirlpool," where the chasm was about eight hundred feet wide, and over two hundred feet deep. As the project was a novel and bold undertaking, and generally believed to be impracticable, a circular letter was addressed to a number of the leading Engineers of America and Europe, asking their opinion of the undertaking. Various replies were received, some in open condemnation of the project, others expressive of grave doubts of its practicability and safety at any cost.

Charles Ellet, Jr., John A. Roebling, Samuel Keefer, and Edward W. Serrell, alone favored the project, and it is a somewhat remarkable coincident that each of these Engineers have since constructed a suspension bridge over the Niagara river, below the Falls, thus demonstrating the accuracy of their early faith. The following letter was received from Colonel Ellet, dated Philadelphia, October twelfth, eighteen hundred and forty-five:

"In the case which you have presented, I can, however, say this much with all confidence: A bridge may be built across the Niagara below the Falls, which will be entirely secure, and in all respects fitted for railroad uses. It will be safe for the passage of locomotive engines and freight trains, and adapted to any purpose for which it is likely to be applied. But to be successful it must be judiciously designed, and properly put together; there are no safer bridges than those on the suspension principle, if built understandingly, and none more dangerous if constructed with an imperfect knowledge of the principles of their equilibrium. To build a bridge at Niagara has long been a favorite scheme of mine. Some twelve years ago I went to inspect the location, with a view to satisfy myself of its practicability, and I have never lost sight of the project since. I do not know in the whole circle of professional schemes a single project which it would gratify me so much to conduct to completion."

In eighteen hundred and forty-six a Company was chartered by the Legislature of New York to construct a bridge over the Niagara river, at or near the Falls, with power to connect with any other Company for that purpose. A charter with similar provisions was granted to a Company in Canada by the Provincial Parliament, and approved by the Home Government. After repeated efforts, made during this and the following year, subscriptions to the capital stock, sufficient to warrant the commencement of the work, were secured, and soon thereafter plans and estimates were invited. The following letter relating to the subject was written by Colonel Ellet, dated Philadelphia, February thirteenth, eighteen hundred and forty-seven :

CHARLES B. STUART,

Commissioner of the Niagara Bridge Company.

DEAR SIR,—I promised to give you my views of the practicability and probable cost of the proposed bridge across Niagara river below the Falls. Immediately after inspecting the site, in eighteen hundred and forty-five, I gave the whole subject a careful investigation, and made a fair, but not extravagant, estimate of the cost of such a structure as I thought would be appropriate and of adequate strength.

This estimate amounted to two hundred and twenty thousand dollars for a railroad bridge competent to sustain the weight of locomotive engines and heavy freight trains, and one hundred and ninety thousand dollars for one suitable for common travel, with a railway track in the centre, to be crossed by passenger and burthen cars drawn by horses.

When I made my estimate, I had in view a work of the first order, and as I do not wish to be in any way connected with one of a lower grade, I cannot offer to reduce my proposition. But I will now repeat, that a secure, substantial and beautiful edifice, not one, however, equal to the claim of the locality—for nothing can match that—but a noble work of art, which will form a safe and sufficient connection between the great Canadian and the New York railways, and stand firm for ages, may be erected over the Niagara river for the latter sum named. If it should be built by me, or under my charge, it will cost about that sum, and I trust it will be worth the money.

With my best wishes for the success of the enterprise in all its magnificence,

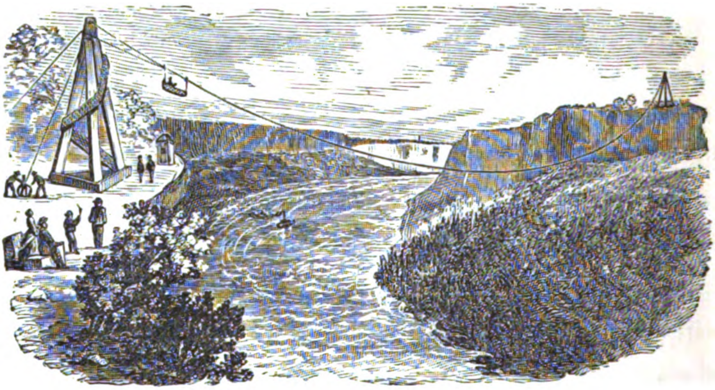
I remain dear sir,
Yours truly,
CHARLES ELLET, Jr.,
Civil Engineer.

On the ninth of November, eighteen hundred and forty-seven, the Directors of the American and the Canadian Niagara Bridge Companies made a contract with Charles Ellet, Jr., for the construction of a railway and carriage bridge over the Niagara river, two miles below the Falls, for the sum of one hundred and ninety thousand dollars. The span was to be about eight hundred feet, and twenty-eight feet in width between parapets, divided as follows: Two carriage-ways, each seven and one-half feet, two foot-ways, each four feet wide, and one railway track in the centre of the floor. Ultimate strength of cables, six thousand five hundred tons. Trains not to exceed twenty-four tons, to be drawn by a locomotive of about six tons weight. The towers to be of stone. The bridge to be tested to two hundred tons, and to be completed by May first, eighteen hundred and forty-nine.

The work was commenced early in the following spring, by the erection of a light structure of nine feet wide, to be used as a service bridge in the erection of the main work, and was also used for a foot-bridge for ten months after its completion in the following July. Its cost was about thirty thousand dollars, and the tolls received during this time amounted to nearly five thousand dollars, notwithstanding the constant interruption to travel by the progress of the work. This bridge was strengthened in the summer of eighteen hundred and forty-eight sufficient to accommodate the ordinary travel of the country until the completion of the present railway bridge in eighteen hundred and fifty-five.

In the summer of eighteen hundred and forty-eight, a difference arose between the contractor and the Directors, respecting the application of the tolls taken on the foot-bridge, which, after some litigation, ended by a compromise, by which Ellet relinquished his contract; and his connection with the work terminated on the twenty-seventh of December, eighteen hundred and forty-eight.

The following letter describes the *first basket ride over the Niagara* by the daring engineer, a faithful sketch of which is given in the accompanying engraving.



ELLET'S BASKET-RIDE OVER NIAGARA RIVER.

NIAGARA FALLS, *March* 13*th*, 1848.

CHARLES B. STUART.

DEAR SIR,—I raised my first little wire cable on Saturday, and anchored it securely both in Canada and New York. To-day (Monday) I tightened it up, and suspended below it an iron basket which I had caused to be prepared for the purpose, and which is attached by pulleys playing along the top of the cable.

In this little machine I crossed over to Canada, exchanged salutations with our friends there, and returned again, all in fifteen minutes.

The wind was high and the weather cold, but yet the trip was a very interesting one to me—perched up as I was two hundred and forty feet above the Rapids, and viewing from the centre of the river one of the sublimest prospects which nature has prepared on this globe of ours.

My little machine did not work as smoothly as I wished, but in the course of this week I will have it so adjusted that anybody may cross in safety.

Truly yours,
CHARLES ELLET, Jr.

In eighteen hundred and forty-seven and eight Colonel Ellet constructed a wire suspension bridge across the Ohio river at Wheeling, remarkable at the time as the longest span in the world—one thousand and ten feet. This bridge was built for a roadway and foot-bridge ; was twenty-four feet wide, and ninety-seven feet above the low water in the river. The weight of the bridge was nine hundred and twenty pounds per lineal foot, supported by twelve cables, six on each side, with an aggregate number of wires of six thousand six hundred, number ten, Birmingham gauge. This bridge was destroyed on the seventeenth of May, eighteen hundred and fifty-four, by a violent tempest of wind. The floor was torn by the force of the wind into three sections ; the eastern portion measured five hundred feet, the western three hundred feet, leaving the central part about two hundred feet long. All the cables but two broke in succession from the anchorage; one cable, composed of one hundred and fifty wires, broke in the centre.

In eighteen hundred and forty-nine Colonel Ellet made a very elaborate report on a railroad suspension bridge across the Connecticut river at Middletown, in which he discussed with much minuteness the whole subject of this class of bridges. The span he proposed was one thousand and fifty feet; the floor elevated one hundred and forty feet above the surface of the water.

The same year he proposed to construct a suspension bridge across the Ohio at Cincinnati, with a single span of one thousand four hundred feet, at an elevation of one hundred and twelve feet. The proposed height of the towers was two hundred and thirty feet above low water, the floor to be suspended from twenty wire cables, each four inches in diameter—deflection one hundred feet, width twenty-six feet, permanent weight of bridge eight hundred and twelve tons, moving load four hundred and fifty tons, or six hundred and forty-three pounds per lineal foot; estimated cost, three hundred thousand dollars.

This was his second offer to construct this work, in reference to which he remarks: "It is now nine years since I gave formal assurance to many of your citizens that it was quite within the present state of art and mechanical knowledge, to throw a bridge over the Ohio which should offer no obstruction to the current, nor appreciable impediment to the navigation. I cannot say that further experience has strengthened that opinion, for the fact was susceptible of absolute proof then."

In the same year he contributed to the Smithsonian Institute a very interesting and valuable manuscript, on the physical geography of the Mississippi Valley, with suggestions for the improvement of the navigation of the Ohio and other rivers.

In eighteen hundred and fifty, Colonel Ellet was appointed Chief Engineer of the Hempfield Railroad, a short but important line, connecting the city of Wheeling with the Pennsylvania Railroad, at Greensburg. While thus engaged, he conducted, on the part of the city of Wheeling, the controversy in regard to the location of the western division of the Baltimore and Ohio Railroad, and published two reports in which he supported the "Grave Creek route," over the "Fisk Creek route."

Colonel Ellet passed the winter of eighteen hundred and forty-nine and fifty, in Washington, in the endeavor to obtain from Congress a small appropriation for the purpose of testing a plan for the improvement of the Mississippi and Ohio rivers, by means of reservoirs, which had become a favorite project of his life. The bill passed the Senate, but was defeated at the last moment, in the House. He then accepted an appointment from Mr. Conrad, Secretary of War, to examine into the floods of the Mississippi river, and report upon their causes, as well as some plan for the prevention of their destructive influence. He spent the winter of eighteen hundred and fifty–fifty-one, in a close examination of the Lower Mississippi, its channels and deltas, and made many original observations upon the formation of the bars at the mouth of the river. He gave the results of his labors in a report to the War Department. This report he afterwards incorporated with his "Memoir on the Ohio River," printed by the Smithsonian Institute, entitled, "Ellet on the Mississippi and Ohio Rivers." This work presents, with its author's beauty of style, and originality of thought, the plan which was, in his estimation, the crowning conception of his professional career, that on which he rested his hopes of future fame. It was to this plan of improving the navigation of the great rivers of the country, by means of vast reservoirs erected at their head-waters, by which the surplus water of the seasons of floods might be stored up, to be set free in the droughts of summer, that he devoted his most earnest thought, until his interest was diverted from every subject connected with his profession, by the political difficulties of the country. It was certain that one feature of this comprehensive plan, which rendered it so captivating to Colonel Ellet's mind and heart, was its general utility to the whole country, tending by its wide-spread benefits, to draw more closely the bonds between the North and South.

In eighteen hundred and fifty-three Colonel Ellet accepted the position of Chief Engineer of the Central Virginia Railroad, and, during a connection of some years with this work, had occasion to familiarize himself thoroughly with the public improvements of the State of Virginia, in regard to many of which he was consulted. In order to bring this road into immediate use, while waiting for the completion of a long tunnel through the Blue Ridge, he constructed a temporary track across the mountain at Rock Fisk Gap, which, from its steep grades and sharp curves, attracted considerable attention from Engineers at home and abroad. Maximum grade two hundred and ninety-six feet per mile. Least radius of curvature two hundred and thirty-four feet.

In eighteen hundred and fifty-two he offered, in response to a call from the citizens of Georgetown, a second plan and report for a suspension bridge across the Potomac river.

Colonel Ellet passed the years of eighteen hundred and fifty-four and fifty-five in Europe, partly in the service of the Virginia Central Railroad, and partly on account of his health. He took a lively interest in the Crimean War; and when the Russian fleet was closely blockaded by the Allies in the harbor of Sebastopol he perfected a plan for destroying ships of war by means of steam rams, already suggested by observations upon the usual results of collisions at sea, and offered it to the Russian Government at a time when, if adopted, it must have resulted in the destruction of the entire Allied fleet. Before returning to the United States, and immediately afterwards, in view of the possible contingency of a war with Great Britain, Colonel Ellet wrote several letters to the Secretary of the Navy, urging his plan upon the Department, but, failing to attract other attention than a courteous acknowledgment, he issued in eighteen hundred and fifty-five a pamphlet, entitled "Coast and Harbor Defences, or the Substitution of Steam Battering Rams for Ships of War," addressed to Congress, which fully justifies his claim to be considered the author of this new mode of naval warfare. The pamphlet attracted much attention at the time, particularly in the Southern States, where Colonel Ellet was well known, and which were subsequently the first to put his views into practice, and in a cause opposed to his patriotic sentiments and principles.

On his return from Europe, after a brief residence in Philadelphia and Richmond, in the service of the Virginia Central Railroad, he settled in Washington for the purpose of carrying a bill through Congress for an appropriation only sufficient to enable him to demonstrate, on a small scale, the practicability of his Reservoir plan for the improvement of the Mississippi river. He had, at the opening of the session, every hope of success; but Congress soon became so absorbed in the political questions of the day, that he found it impossible to accomplish his purpose. The bill passed the Senate, as before, and was lost in the House. He then retired to his country seat on the Heights of Georgetown, but was called from thence, in eighteen hundred and fifty-eight, to survey the Great Kanawha, with a view to ascertaining the applicability of his Reservoir system to the improvement of that river.

As early as the summer of eighteen hundred and sixty-one his attention was attracted by references in the Southern newspapers to certain vessels in course of construction in the harbors of Norfolk, Mobile, and New Orleans, and he became convinced that the rebels were putting into execution his plan for steam battering rams. He endeavored, by a series of letters to the Secretary of the Navy, to arouse the Department to a sense of the menacing danger, and, failing in this, a few weeks before the naval disaster in Hampton Roads, in his second pamphlet, he gave a startling warning in regard to the steamer Merrimac in words which might serve as a description of her subsequent deeds.

A few days after the battle of Hampton Roads, on the receipt of alarming telegrams from the West, Colonel Ellet was commissioned by the War Department to do what he could, speedily, to aid and protect the Mississippi gunboat squadron against a fleet of rebel rams, understood to be advancing up the river. The need was too pressing to admit of the construction of boats. In six weeks Colonel Ellet had procured and so strengthened nine ordinary river steamboats as to serve temporarily as rams. Of this fleet he was placed in independent command, with the rank of Colonel, and proceeded at once with his unfinished and ill-protected wooden vessels down the river. Detained for some time above Fort Pillow by the unwillingness of Commodore Davis, commander of the gunboat squadron, to advance, he became so uneasy lest the rebels should desert Forts Pillow and Randolph, that he pushed down alone, and, taking possession of the forts, found his fears realized, the rebels having retired the preceding night.

On the sixth of June, eighteen hundred and sixty-two, the battle of Memphis was fought. Colonel Ellet had given orders that the Stars and Stripes at the masthead of his flag-ship should be the signal to his little fleet to follow him at once into action. On that morning, at the first shot from the rebel fleet of iron-clad vessels and rams, Colonel Ellet hurried on deck of his vessel, the "Queen of the West," and waving his hat to his brother Alfred, who commanded the "Monarch," next in order, he caused his flag to be run up, and his vessel to bear down upon the foe. The "Monarch" alone obeyed the signal, and, in presence of both fleets, and of the thousands of spectators who lined the shores, these two wooden boats passed through an iron squadron, and selecting two of the most prominent of the advancing fleet, ran them down. The two rebels boats sank—the one instantly, the other in a few moments—with all their living freight; the "Monarch" was uninjured; the "Queen of the West" received a blow which rendered it necessary for her, shortly, to go ashore. The results of the engagement were, that of the eight rebel boats, three were sunk outright by his two rams, two were captured, and one escaped below; the remaining two were disabled by long shots, and captured by the gunboats. During the encounter with the enemy, Colonel Ellet became so much interested in the practical illustration of his theory, and so anxious to witness the result, that he again stepped out alone upon the deck, and received a pistol shot in the knee from the hand of some one on the sinking ship struck by the "Monarch." His wound was not, at first, deemed serious. He sent a number of despatches to the Secretary of War, continued in command of his fleet, and sent his young son, with three companions, before the firing had ceased, to demand the surrender of the city, and to replace the rebel flag upon the post-office by his own. The order was executed with great gallantry, in presence of a large and hostile crowd. In the course of a few days it became evident that his feeble frame could not resist the effects of a wound which would have proved fatal to a stronger constitution. Colonel Ellet was transferred from his flag-ship to the "Switzerland," and, even when sinking under the heat of the climate, and assured by his physicians that his only hope of recovery lay in a prompt removal, he refused to have the vessel turned back for his accommodation until he ceased to notice external things, when his brother Alfred, who had taken temporary command, had the course of the boat directed up the river. He was taken to Cairo, at which point, on the twenty-first of June, eighteen hundred and sixty-two, surrounded by his family, who had been able to join him, he breathed his last, so peacefully that it was truly a "falling asleep."

Great as was his professional reputation and his fame as a soldier and patriot, it will never exceed the high regard in which he was held by those who were favored by his intimate acquaintance and friendship. Colonel Ellet possessed many sterling qualities. His whole conduct was governed by a high sense of integrity and honor. His friendship was reliable and unselfish. When wronged, his pride was quickly aroused, even to an appearance of conceit, which, however, could be attributed to strong convictions of being right, and a consciousness of superiority over those by whom he was unjustly treated.

In personal appearance Colonel Ellet was tall, spare in figure, but commanding in presence. His eyes dark and piercing, and when aroused in a controversy that called out the energies of his mind, his eloquence was like a mountain torrent, carrying away every opposing obstacle. In his domestic relations no one could have been more happy. His devotion to his excellent and accomplished wife knew no bounds, while his tenderness to his children was excessive.

His accomplished daughter writes: "As for the dear task of giving a sketch of my late father's domestic life, I am utterly unfit for it now. You, who knew him only as men could know, will yet understand, when I say that to me he is the embodiment of all that is noble, gentle, generous and great. You say rightly that, in the social and domestic sphere, he was as distinguished as in his professional life. He has left by his pen and his public works a record that must one day establish his fame before the world, but it was at home, as a parent, a husband, and a friend, that his superiority over other men was most manifest. Our household was truly, as I have often heard it called, a home of love. You must have known something of his devotion to my mother—a feeling the mainspring of his whole life—my mother, whose cheek he would not have the 'winds of heaven visit too roughly.' His tenderness to his children exceeded anything that I have ever known. Indifferent, almost averse, to society, he lived in his little home circle, his office was the family sitting-room, he wrote his most labored works and carried on his most abstruse calculations with his wife beside him, and his little children climbing on his chair. In sickness he was their kindest nurse, in every difficulty their tenderest friend—they played with him, sought his counsel, displayed for him each little accomplishment, and obeyed him with a passionate love that had in it little or nothing of fear.

"I do not think he ever expected to live through the war. At the very outset he made his will, as we subsequently learned, leaving everything he possessed to his beloved wife, for the express purpose, as he states, of making their children dependent upon her for their means of support. I shall never forget one evening when I urged upon him the question of the unfortunate termination of the Union. At first he refused to consider such a possibility, and when I pressed it upon him he said, with a look that silenced me: '*At least I shall not live to see it.*'"

Colonel Ellet left two sons; the oldest, Charles Rivers Ellet, whose youth gave every promise of a brilliant manhood, was with his father at the battle of Memphis and won great credit. Immediately after his father's death he received the appointment of Colonel of the Ram Fleet, though barely eighteen years of age, and in that command achieved feats of gallantry which made his name and fame celebrated along the Mississippi, having run his wooden vessels twice past the batteries of Vicksburgh. His health was undermined by the climate, and he died at the early age of nineteen. The other son is a promising boy, still at school.